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MILLING, BAKING, AND CHEMICAL EXPERIMENTS WITH HARD RED SPRING WHEAT  
1952 CROP 1/

BY

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- 1/ Cooperative investigations of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration and the Grain Branch, Production and Marketing Administration. The samples were obtained from the cooperative experiments with the State Agricultural Experiment Stations in the spring wheat region.

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## INTRODUCTION

Samples of the standard varieties and many of the new strains of hard red spring wheats, grown in cooperative experiments in the spring wheat region 2/ of the United States, are milled each year by the United States Department of Agriculture and the flours baked into bread to determine their quality characteristics.

The baking methods and techniques used on the 1952 crop were essentially the same as used in testing the wheat varieties and strains for the 1944 to 1951 crops, inclusive.

The purpose of this report is to make available to cooperators the quality data from the 1952 crop obtained from standard varieties, new strains, and commercial hard red spring wheat.

## SOURCE OF SAMPLES

Tests were made on composite and individual samples of the uniform varieties and of many other varieties and strains grown in plot experiments at cooperating stations. These included samples grown at Madison, Wis.; St. Paul, Morris, and Crookston, Minn.; Fargo, Langdon, Edgeley, Williston, Minot, and Dickinson, N. Dak.; Brookings, Eureka, and Highmore, S. Dak.; and Havre, and Moccasin, Mont. Similar tests were made on Eastern and Western Composites of the 26 strains grown in the Uniform Regional Nurseries; on the wheats from the supplementary yield nurseries; and from the station nurseries at Havre, Moccasin, and Choteau, Mont., and Madison, Wis. Tests were also made on a number of foreign varieties and strains grown at Choteau, Montana, and wheats grown under different fertilizer treatments in Montana.

There were also included 15 samples composited from samples of carlot receipts of wheat accumulated during a 90-day period of the 1952 crop movement by the Minneapolis, Duluth, and Great Falls offices of the Grain Branch, Production and Marketing Administration. These samples represent country-run receipts of the class hard red spring wheat and included only those lots that were graded No. 3 or better under the official grain standards of the United States. These hereafter referred to as commercial samples. This is the fourteenth season that such samples have been collected and tested.

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1/ Ausemus, E. R. Results of spring wheat varieties grown in cooperative plot and nursery experiments in the spring wheat region in 1952. U. S. Dept. Agr., Bur. Plant Indus., Soils, and Agr. Engin., Div. Cereal Crops and Dis. 271 CC, 64 pp. April 1953. University Farm, St. Paul 1, Minn. Processed.

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## METHODS USED IN MILLING AND BAKING TESTS

After the removal of dockage, the samples were prepared for milling by use of a milling separator and a scourer (both machines of experimental or laboratory size). The wheat samples were tempered in two stages. The water for the first temper was added 72 hours prior to milling and raised the moisture content of the grain to between 13.0 to 16.0 percent or within 1 percent of the total moisture required depending upon the hardness of the variety. The additional 1 percent of water for the second temper was added 1/2 hour before milling and raised the moisture content of the grain to between 14.0 and 17.0 percent. The wheat was milled on a Buhler automatic laboratory flour mill provided with three break and three reduction rolls. A 90 percent patent flour used in the chemical and bread-baking tests was made and the low grade flour discarded. However, the flour yield data in the tables are reported on the basis of a straight grade flour (100 percent) obtained from each sample.

The test-weight-per-bushel of each sample was determined in the laboratory on the dockage-free wheat. The protein and ash contents are reported on a 14.0 percent moisture basis and the flour yield on a moisture-free basis.

The hardness of the grain was determined by pearling 20 grams of dockage-free whole wheat for 1 minute in a model No. 38 Strong-Scott Pearler. The amount of material pearled off expressed as a percentage of the wheat is called the pearling index. This pearling index has been found useful not only as a guide in tempering the samples for milling, but also as a measure of the hardness of the grain. A low index figure indicates hard grain and a high index figure indicates soft grain.

The bread-baking tests on the 1952 samples (same as used on the 1944 to 1951 samples inclusive) were made by a rich formula with none or varying amounts of potassium bromate added.

The method used in 1952 with the various ingredients is shown in table 1.



Table 1.--Baking method and ingredients used for samples of the 1952 crop.

Ingredients and treatment	Weight of ingredients, etc.
Flour (grams)	100.0
Yeast (grams)	2.0
Salt (grams)	1.5
Sugar (grams)	5.0
Potassium bromate $\frac{1}{2}$ (mgs.)	Optimum
Malted wheat flour (grams)	.25
Nonfat dry milk solids (grams)	4.0
Shortening (grams)	3.0
Water absorption (percent)	Optimum
Mixing time (minutes)	Optimum
Fermentation time (minutes)	180
Handling of dough	1st punch after 105 minutes 2nd punch after additional 50 minutes Mold after additional 25 minutes Proofing time - 55 minutes Baked 25 minutes at 450° F.

$\frac{1}{2}$  0 to 3 mgs. of potassium bromate used as necessary to obtain maximum loaf volume.

This baking procedure is based on the method of the American Association of Cereal Chemists, with certain modifications deemed necessary for unbleached, experimentally-milled flour.

A check or standard flour (12.8 percent protein and 0.47 percent ash on a 14.0 percent moisture basis) was included in the baking trials with each day's tests. The average loaf volume of baking tests made with the standard flour was 814 cc. and the standard error was 14.7 cc. On this basis the least significant difference between 2 single bakes is 42 cc.

The undersirable property of each variety with respect to grain and texture and crumb color characteristics of the bread is indicated in the tables by "q" for questionable and "u" for unsatisfactory, adjacent to the numerical data pertaining to the property in question. No letter or other symbol with the numerical score is used to indicate a satisfactory rating. The following scores may be used as an index for judging the grain texture and crumb color quality of the bread:

59 or below	Very poor or unsatisfactory
60 to 69	Poor or questionable
70 to 79	Fair
80 to 89	Good
90 to 99	Very good
100 and above	Excellent

Bread loaf volume must also be adequate for the protein content of the flour, if the variety is to be considered satisfactory. Loaf volume at different protein levels determined in previous tests may be used as a guide in appraising the data in this report. The loaf volumes expected for any given flour protein content are as follows:

<u>Flour Protein</u> <u>Pct. 1/</u>	<u>Loaf Volume</u> <u>(Cc.)</u>
8.0	605
9.0	660
10.0	700
11.0	750
12.0	820
13.0	865
14.0	905
15.0	960
16.0	1005
17.0	1055
18.0	1100

1/ 14.0 percent moisture basis.

Varieties or selections having loaf volumes of approximately 125 cc. less than the expected, as based on the flour protein content, are indicated by "q" (questionable) after the loaf volume figure, and those of less than approximately 200 cc. or more are identified by "u" (unsatisfactory) following the numerical loaf volume figures in the tables. No letter indicates a satisfactory volume.

An unsatisfactory rating on one or more of the properties indicates that the variety or strain is generally undersirable for hard wheat milling or bread making purposes. The milling properties are discussed in the text material and should be considered along with the bread baking properties. A questionable rating on one or more of the quality properties, on the other hand, may be balanced by other outstanding properties.

#### EXPERIMENTAL RESULTS

The quality results for the plot and nursery composite, yield trial samples, foreign varieties and strains and the wheats grown under different fertilizer treatments are given in tables 2 to 9. The results for the commercial samples are shown in table 10 and the correlation and regression coefficients for five varieties and strains are shown in table 11. Summaries of the new strains of current interest compared with Thatcher are shown in table 12. These tables are largely self-explanatory. The varieties or strains are arranged in the tables in order of their maximum loaf volume. Acre yields are included, where comparable, to assist in the interpretation of results.

## COMPOSITE OF UNIFORM PLOT VARIETIES

The results from the eastern uniform composite plots are given in table 2. Five varieties were grown uniformly at stations in the eastern half of the region. Quality data based on a composite of the grain from these plots are given in table 2. Of the five varieties it will be noted that Lee had the highest protein content as well as the highest yield and produced the best loaf of bread. Thatcher was somewhat deficient in crumb color and grain texture score. Other differences were probably within the limits of experimental error.

Rival and Mida, considering the data as a whole, appear to be the best. Both made bread satisfactory in grain and texture and crumb color and were also highest of the group in yield of flour. Lee was highest in protein content and loaf volume.

## STATION PLOT EXPERIMENTS

The quality data for the uniform varieties and a number of strains grown in plots at many of the stations in the region are grouped by States for the purpose of this discussion. The data are shown in table 3.

The Madison, Wis., samples were relatively low in wheat and flour protein but in general were high enough to produce satisfactory bread. Henry produced the largest loaf but was somewhat deficient in crumb color. Thatcher, Sturgeon and Lee gave relatively poor loaves of bread although about average or in the case of Lee above average in protein content.

Thatcher x Surpresa, 1764 x Henry, and H-194-41, considering the data as a whole, made the best bread of the strains tested. None of these are as strong as Thatcher, but approach or are equal to Mida with a few exceptions, which will be mentioned later.

Thatcher x Surpresa has yielded a fairly high percentage of flour for a test weight of 60.8 pounds and exceeds Thatcher, Henry, and Sturgeon in protein content. The dough mixing time is about 20 percent shorter than some of the standard varieties and the dough handling characteristics are slightly weak which may be a seasonal response. Strain 1764 x Henry has yielded less flour than either Thatcher or Henry, but otherwise milled satisfactorily. Samples of 1764 x Henry tested from other stations in the hard red spring wheat area have shown it to have the same low flour yield characteristic and, in addition, a number of the samples have shown poor milling properties. Some mill chemists have found the dough mixing time longer (we have not) than that of the standard varieties and object to this strain for that reason. Strain H-194-41 has made good bread considering its low flour protein content. The loaf volume is about that expected for a 9.7 percent flour protein content and the internal bread characteristics satisfactory. The dough properties were slightly weak, perhaps a seasonal characteristic. The dough mixing time was longer than that of the standard varieties. It should be noted that strain H-195-45 also had a long-mixing time and has made bread, nearly as good as that from strain H-194-41. Both of these strains milled well and yielded a high percent of flour.



Henry x Cadet N.No. 2239 has made acceptable bread which is comparable, considering the data as a whole, to that from Mida.

The Minnesota samples, grown in plots at Crookston, St. Paul and Morris, show the variety Lee, considering the data as a whole, to be the best of the samples tested. It averaged about 1 percent higher than the other comparably grown wheats in protein content. It ranked third at Morris in loaf volume, but was best of the group in grain and texture, and crumb color.

The strain 1764 x Henry N. No. 2211 was lowest in protein content at two of the three stations. Bread baked from it was satisfactory but, considering all data this variety ranked lower than most of the varieties with which it was compared.

Plot samples were received from six stations in North Dakota. Lee, considering the data as a whole, appears to be the best variety tested from most of the stations. It was relatively high in protein content and loaf volume and the bread was satisfactory in crumb color, grain and texture. The strain 1764 x Henry was next best. It also ranked high in protein content and loaf volume at most stations. At Williston it was lowest in over-all quality, although one of the highest in protein content. It appears, at all stations, to be much like Thatcher in that it has a low crumb color score.

A number of the varieties produced a remarkably high percentage of flour, considering the test weight per bushel of the wheat. Rival perhaps averaged best in this respect among the wheats compared. It is of interest to note the relatively low flour ash contents for so many of the high flour-yielding varieties.

The South Dakota samples were received from three stations, Eureka, Highmore, and Brookings.

The Eureka and Highmore samples will be discussed together since the same varieties and strains were grown at both places. Rushmore, Cadet, 1764 x Henry and Mida, from Eureka, South Dakota, and Rushmore, Mida, Cadet, and Rival from Highmore, South Dakota, have made the best bread considering the data as a whole. It is of interest to note that at the Eureka station four of the samples -- Rushmore, Mida, Rival, and Lee produced a high yield of flour, which was higher than that usually expected for the test weight per bushel of the samples.

The poorest bread from these two stations was made from Rushmore<sup>2</sup> x Surpresa P.W.36. The loaves of bread were unsatisfactory in crumb color and grain and texture. The loaf volumes were low being about 35 percent lower than expected based on protein content. Both samples had a short dough mixing time and were much lower in water absorption than Rushmore or Mida. A short dough mixing time such as found in this strain is a definite objectionable characteristic in a variety. In addition to the short dough mixing time, the dough properties were weak and not elastic. This strain is definitely a poor bread wheat on the basis of the Eureka and Highmore results.

The samples of Triunfo x Thatcher 630 -- from the same two stations - made questionable bread. Their loaf volumes were lower (about 15.0 percent) than expected from their protein contents. The grain and texture of the bread was only fair, and the dough mixing time short. The dough handling properties were weak and the water absorption lower than that of Rushmore. The Highmore sample milled fair, the flour being difficult to bolt or sieve. The Eureka sample milled satisfactorily. Triunfo x Thatcher 630 is a stronger wheat than Rushmore<sup>2</sup> x Surpresa P.W. 36, but neither strains appear to be promising bread wheats based on the results from these two stations.

Of the new strains from these stations, 1764 x Henry N. No. 2211 appears to be the best, considering the data as a whole.

Eighteen varieties and strains were received from the Brookings, South Dakota, station. Most of the samples made acceptable bread. However, some samples were deficient in one or more properties (milling, dough mixing times, etc.) indicating they are of questionable value for bread.

Rushmore<sup>2</sup> x Surpresa P.W.36 and Rushmore x Java P.W.8 had considerably shorter dough mixing times than either Rushmore, Thatcher or Mida. Thatcher x Surpresa, C.I. No. 12641, Triunfo x Thatcher 630, Rushmore<sup>2</sup> x Surpresa P.W.114 and Rushmore x Java had slightly shorter dough mixing times than the standard varieties. Rushmore<sup>2</sup> x Surpresa P.W.36, Rushmore x Java, and Rushmore x Java P.W.8 were deficient in dough handling properties, being slightly weak and not as elastic or pliable as Rushmore. Triunfo x Thatcher 630 milled fair, the bran being tough and difficult to clean free from flour. Thatcher x Surpresa C.I. No. 12641 milled satisfactorily, but the flour was very soft to the touch and not as granular as that from the standard varieties.

Of the new strains, H.R.P. x Clarendon N. No. 2202, and Henry x Cadet, C.I. No. 12781, seem to be best, considering the data as a whole. These two are similar in many respects to Rushmore. It should be pointed out that Rushmore<sup>2</sup> x Surpresa P.W.114 has made generally acceptable bread. It has a shorter dough mixing time than Rushmore, which may not be too objectionable considering its other characteristics. It is a better wheat than Rushmore<sup>2</sup> x Surpresa P.W.36 on the basis of the Brookings sample.

Plot varieties and strains were received from the Havre and Moccasin, Montana stations. The primary purpose was to evaluate the quality of 1764 x Henry - N.No. 2211 as compared with Thatcher, Mida and Lee. The results indicate that 1764 x Henry N. No. 2211 is not so strong as Thatcher, but equal at least to Lee, except with respect to flour yield. Data from this laboratory over the past years, indicates that N. No. 2211 yields slightly less flour than Thatcher of comparable test weight. Some lots were found to be questionable as to milling properties. In some cases the middlings have been hard to reduce to flour. The sample from Moccasin, this year as well as a number of samples tested from the 1950 crop was rated as unsatisfactory in milling. Some of the mills in the spring wheat region have found the dough mixing time longer than that for the standard varieties, and have objected to N. No. 2211 on this basis. Our results have shown it to be about the same in mixing time as most of the commercially acceptable wheats. N. No. 2211, however, has consistently exceeded Thatcher in protein content.



Table 2.-- Yield, milling, baking and chemical results on the uniform varieties of hard red spring wheat grown at experiment stations from the Eastern composites of the 1952 crop.

Eastern Composite 1/

Variety or Cross	State or N. No.	C. I. No.	Acre Yield	Test Weight	Pearl- Index	Protein	Flour Yield	Ash	Pot.	Pot.	Pot.	Min.	Mg.	Optimum Baking Methods				
														Absorp- tion	Mixing Time	Loaf :Crumb: Grain Bromate:Volume:Color:Texture		
			Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pot.	Pot.	Pot.							
Lee		12488	21.5	59.5	30	15.1	14.1	73.0	.49	65	65	3.0	1	929	85	95		
Rival		11708	18.9	58.6	28	13.5	12.7	75.9	.54	66	66	2.5	1	897	95	95		
1764 x Henry	2211	12733	20.5	57.8	28	13.8	12.8	71.8	.43	64	64	2.0	1	897	80	95		
Thatcher		10003	17.3	58.3	26	13.8	12.9	73.6	.50	64	64	2.5	2	893	70	85		
Mida		12008	18.1	60.0	29	13.9	12.9	75.7	.52	63	63	2.0	1	847	90	95		
Average		19.3	58.8	28	14.0	13.1	74.0	.50	64	64	64	2.4	1.20	893	84	93		
Range		4.2	2.2	4	1.6	1.4	4.1	.11	3	3	3	1.0	1.00	82	25	10		

1/ Madison, Langdon, Crookston, St. Paul, Morris, Waseca and Edgeley stations.

Table 3.--Yield, milling, baking, and chemical results for the hard red spring wheats grown in replicated "plots" in 1952

Madison, Wisconsin

Variety or Cross	State or N. No.	C. I. No.	Acres	Yield: Bu.	Test Weight: Lbs.	Pearl- ing Index	Protein	Flour Yield: Pct.	Ash	Absorp- tion	Mixing: Time	Optimum Baking Methods		
												Loaf: Volume	Crumb: Color	Grain Texture
							Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Co.	Score
Henry		12265	26.3	57.8	33	12.0	10.8	75.6	.52	62	2.5	0	732	75
Henry x Cadet	2239	12779	27.2	57.8	27	12.6	11.2	72.0	.54	63	2.5	0	719	80
Mida		12008	23.8	58.5	27	12.9	11.3	73.2	.54	63	2.5	0	716	80
Rival		11708	25.7	58.7	28	12.5	11.0	74.0	.56	64	2.5	0	709	85
Thatcher x Surpresa	II-39-8	12641	26.1	60.8	28	12.6	11.1	73.4	.47	60	2.0	0	709	85
Lee		12484	26.2	58.1	27	13.1	11.4	70.5	.51	64	2.5	0	680	80
Thatcher		10003	23.0	58.2	21	12.0	10.6	72.6	.55	62	2.5	1	680	70
1764 x Henry	2211	12733	25.6	57.7	26	11.6	10.3	71.5	.44	63	2.5	0	678	85
H-195-45	W242	12484	27.6	58.9	29	11.4	10.1	73.6	.47	63	3.0	0	662	85
H-194-41	W246	12649	26.5	58.2	26	11.0	9.7	73.0	.43	60	3.0	0	651	85
Sturgeon		11703	28.5	60.6	34	12.3	10.7	70.8	.49	60	2.0	0	640	90
Average		26.0	58.7	28	12.2	10.7	72.7	.50	.50	62	2.5	.91	689	82
Range		5.5	3.1	13	2.1	1.7	5.1	.13	.13	4	1.0	1.00	92	20
														10
St. Paul, Minnesota														
Lee		12488	16.3	60.8	25	13.1	12.1	72.6	.54	67	2.5	0	785	80
Rival		11708	10.2	58.1	22	12.6	11.8	75.5	.55	66	2.5	0	771	80
Thatcher		10003	8.5	58.6	21	12.6	11.7	73.1	.52	63	2.5	0	757	70
Mida		12008	11.3	59.0	25	13.0	11.9	74.0	.50	62	2.0	0	751	80
1764 x Henry	2211	12733	15.1	58.0	22	11.2	10.4	71.8	.44	65	2.0	0	727	70
Average		12.3	58.9	23	12.5	11.6	73.4	.51	.51	65	2.3	0	758	76
Range		7.8	2.8	4	1.9	1.7	3.7	.11	.11	5	.5	0	58	10



Table 3.--Continued.

## Crookston, Minnesota

Variety or Cross	State or N. No.	C. I. No.	Acre	Test Weight	Pearl- Index	Protein	Flour Yield	Ash	Absorp- tion	Mixing Time	Optimum Baking Methods			
											Loaf Volume	Crumb Color	Grain Texture	
			Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score	
Lee		12488	18.6	58.5	31	15.3	14.4	75.3	.42	65	2.0	1	891	90
Thatcher		10003	18.9	57.7	26	14.1	13.2	75.3	.43	66	2.0	0	884	70
Rival		11708	19.4	59.0	31	12.8	12.1	77.8	.47	65	1.5	0	843	80
Mida		12008	17.5	59.5	29	13.6	12.7	76.4	.46	64	2.0	0	830	85
1764 x Henry	2211	12733	20.2	58.4	30	13.7	12.9	74.1	.41	64	1.5	1	830	80
Average			18.9	58.6	29	13.9	13.1	75.8	.44	65	1.8	.40	856	81
Range			2.7	1.8	5	2.5	2.3	3.7	.06	2	.5	1.00	61	20
														0

## Morris, Minnesota

Rival		11708	21.7	52.1	23	13.0	12.2	74.4	.54	66	2.5	1	864	90
Thatcher		10003	26.5	54.3	24	13.2	12.6	75.1	.50	63	2.5	1	863	85
Lee		12488	37.9	58.7	31	14.1	13.7	74.8	.45	66	2.5	1	833	95
1764 x Henry	2211	12733	31.7	55.4	27	12.7	11.7	72.6	.41	66	2.0	1	828	90
Mida		12008	23.0	56.4	25	13.0	12.2	74.5	.48	64	2.0	2	788	90
Average			28.2	55.4	26	13.2	12.5	74.3	.48	65	2.3	1.20	835	90
Range			6.2	6.6	4	1.4	2.0	2.5	.13	2	.5	1.00	76	5

## Fargo, North Dakota

1764 x Henry	2211	12733	13.9	60.0	28	13.7	12.5	71.2	.42	66	2.0	0	838	75	85
Lee		12488	17.7	61.4	29	15.1	14.3	73.4	.46	67	2.5	1	838	90	90
Thatcher		10003	16.9	60.2	26	13.7	12.7	73.5	.51	66	2.0	0	836	80	90
Rival		11708	18.0	60.6	27	13.0	11.9	76.4	.52	67	2.5	0	791	85	90
Mida		12008	17.7	61.3	29	12.9	11.9	76.0	.49	66	2.0	0	786	85	85
Average			16.8	60.7	28	13.7	12.7	74.1	.48	66	2.2	.20	818	83	88
Range			4.1	1.4	3	2.2	2.4	5.2	.10	1	.5	1.00	52	15	5

Table 3.--Continued.

## Langdon, North Dakota

Variety or Cross	State or N. No.	C. I. No.	Acres	Test Weight	Pearl- ing Index	Protein		Flour		Absorp- tion	Maxing Time	Optimum Baking Method			
						Wheat	Flour	Yield	Ash			Bromate	Leav	Crumb	Grain
			Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Co.	Score	Score
Lee 1764 x Henry Rival Thatcher Mida	2211	12488	23.7	62.9	32	15.5	14.7	75.7	.41	67	2.5	2	930	90	85
		12733	22.2	62.3	30	15.9	15.0	73.3	.38	67	2.5	2	899	75	85
		11708	28.2	62.7	29	13.9	13.1	78.7	.45	67	2.5	2	871	85	90
		10003	24.0	61.9	27	13.8	13.1	76.4	.41	67	2.5	1	833	70	85
		12008	27.0	63.8	30	13.6	12.8	76.8	.43	65	2.0	1	820	90	85
Average Range			25.0	60.7	30	14.5	13.7	76.2	.42	67	2.4	1.60	871	82	86
			6.0	1.9	5	2.3	2.2	5.4	.07	2	.5	1.00	110	20	5

## Edgeley, North Dakota

1764 x Henry	2211	12733	13.3	59.5	33	16.7	15.5	72.6	.41	67	2.0	2	1062	80	80
Rival		11708	13.1	60.0	32	15.9	15.0	76.8	.48	67	2.5	1	1043	90	90
Lee		12488	13.3	60.7	37	17.4	16.3	73.7	.42	69	2.0	1	1031	95	95
Thatcher		10003	12.9	60.3	32	16.5	15.4	75.9	.40	65	1.5	1	1009	80	95
Mida		12008	13.3	61.1	34	16.2	15.2	77.1	.44	64	1.5	0	973	95	95
Average			13.2	60.3	34	16.5	15.5	75.2	.43	66	1.9	1.00	1024	88	91
Range			.4	1.6	5	1.5	1.3	4.5	.08	5	1.0	2.00	89	15	15

## Minot, North Dakota

1764 x Henry	2211	12733	21.8	56.6	32	15.1	14.0	71.9	.39	67	2.0	2	950	75	90
Lee		12488	24.8	59.2	32	14.5	13.6	75.3	.43	68	2.5	1	893	90	95
Rival		11708	27.9	58.0	28	13.6	12.9	77.2	.47	68	2.5	1	887	80	95
Thatcher		10003	25.0	57.0	28	13.2	12.3	75.7	.43	65	2.5	0	840	70	90
Mida		12008	26.4	59.5	30	13.2	12.5	76.4	.45	67	2.0	1	820	80	90
Average			25.2	58.1	30	13.9	13.1	75.3	.43	67	2.3	1.00	878	79	92
Range			6.1	2.9	4	1.9	1.7	5.3	.08	3	.5	2.00	130	20	5

Table 3.—Continued.

## Williston, North Dakota

Variety or Cross	State or N. No.	C. I. No.	Acres	Test Weight	Pearl Index	Protein		Wheat Flour		Ash	Absorp- tion		Maxing Time	Optimum Baking Method	
						Bu.	Lbs.	Pot.	Pot.	Pot.	Pot.	Min.	Mg.	Co.	Score
Lee		12488	18.4	62.1	34	16.6	15.6	73.1	.43		68	2.0	0	994	100 90
Thatcher		10003	19.3	61.9	32	15.7	14.9	75.6	.42		66	2.0	0	966	80 85
Mida		12008	18.9	63.3	31	15.5	14.3	76.3	.45		68	2.0	0	908	95 90
1764 x Henry	2211	12733	13.4	61.6	32	16.6	15.6	73.5	.42		69	2.0	0	899	75 85
Average			17.5	62.2	32	16.1	15.1	74.6	.43		68	2.0	0	942	88 88
Range			5.9	1.7	3	1.1	1.3	3.2	.03		3	.0	0	95	25 5

## Dickinson, North Dakota

Thatcher		10003	12.5	59.8	36	16.4	15.4	74.8	.43		64	1.5	1	1049	85 90
1764 x Henry	2211	12733	6.9	59.0	35	17.9	16.7	71.6	.43		67	1.5	2	1025	80 80
Lee		12488	11.1	59.6	39	17.5	16.5	73.0	.44		65	2.0	0	1006	95 90
Mida		12008	12.9	61.0	34	16.3	15.2	74.7	.43		64	1.5	0	945	95 85
Average			10.9	59.9	36	17.0	16.0	73.5	.43		65	1.6	.75	1006	89 86
Range			6.0	2.0	4	1.6	1.5	3.2	.01		3	.5	2	104	15 10

## Eureka, South Dakota

Rushmore		12273	18.4	60.8	35	14.5	13.8	78.3	.51		65	2.5	0	996	90 95
Lee		12488	18.1	60.5	34	14.9	14.0	76.2	.52		67	2.5	0	947	90 90
Cadet		12053	---	59.2	28	14.2	13.4	74.6	.53		69	3.0	0	915	95 100
Thatcher		10003	16.1	59.7	29	13.8	13.1	74.9	.51		66	2.5	0	887	80 85
Tri x Thatcher 630		12625	---	60.4	40	16.5	15.5	71.8	.48		60	1.0	0	877	85 70
1764 x Henry	2211	12733	18.4	59.5	34	13.9	13.0	74.8	.47		63	2.0	0	847	90 100
Mida		12008	16.9	60.1	31	13.3	12.4	77.4	.48		64	2.0	0	843	95 95
Rival		11708	14.8	58.9	30	13.3	12.3	77.5	.52		65	2.5	0	830	85 90
Rushmore <sup>2</sup> x Surpresa P.W.36			19.5	60.3	43	17.1	15.3	73.2	.47		58	1.0	0	640	55u 40u
Average			17.6	59.9	34	14.6	13.6	75.4	.50		64	2.1	0	865	85 85
Range			3.6	1.9	15	3.8	3.2	6.5	.06		11	2.0	0	356	40 60



Table 3.--Continued.

## Highmore, South Dakota

Variety or Cross	State or N. No.	C. I. No.	Acre Yield	Lbs. Test	Pearl- Index	Protein	Flour Yield	Ash	Absorp- tion	Mixing Time	Optimum Baking Methods				
											Bromate Volume	Loaf Color	Crumb Texture		
			Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Co.	Score	Score	
Rushmore Lee Cadet Thatcher 1764 x Henry Mida Rival Tri x Thatcher 630 Rushmore <sup>2</sup> x Surpresa P.W.36		12273	8.2	60.9	35	14.6	13.8	72.4	.50	64	2.0	0	973	95	95
		12488	8.2	60.7	33	14.9	13.9	70.6	.53	68	2.5	0	966	100	85
		12045	9.0	58.8	27	14.0	13.3	73.8	.53	68	2.5	0	915	95	95
		10003	8.8	59.6	29	13.8	13.0	74.4	.52	64	2.0	0	911	80	85
	2211	12733	6.8	59.2	32	13.8	13.0	68.9	.45	64	2.0	1	905	80	90
		12008	6.8	60.1	31	13.3	12.5	74.9	.49	63	2.0	0	880	900	95
		11708	3.0	59.2	29	13.1	12.6	76.6	.52	64	2.5	0	874	100	95
		12625	11.2	60.3	39	16.3	15.0	72.0	.48	60	1.0	0	788	80	65q
		11.8	60.6	43	16.7	15.5	73.8	.48	56	1.0	1	592	55u	55u	
Average			8.2	59.9	33	14.5	13.6	73.0	.50	63	1.9	.22	867	87	84
Range			8.8	2.1	16	3.6	3.0	7.7	.08	12	1.5	1	381	45	40

## Brookings, South Dakota

Brookings, South Dakota															
Thatcher x Surpresa	2824	12641	22.0	63.1	29	13.2	12.2	77.1	.47	61	1.5	0	855	75	90
Triumbo x Thatcher 630		12625	21.8	61.7	32	15.0	13.2	72.9	.49	58	1.5	0	853	90	85
Rival		11708	15.8	56.5	22	11.1	10.5	75.4	.60	65	2.5	0	825	85	90
Cadet		12045	15.4	54.0	24	12.4	11.8	75.1	.56	63	2.5	0	804	85	90
H.R.P. x Clarendon 2202		12731	17.6	58.7	28	12.2	11.4	76.0	.45	58	2.0	0	794	85	85
Henry x Cadet	2239	12779	20.0	58.1	28	12.8	11.9	74.8	.54	62	2.0	0	788	70	85
Ceres		6900	16.2	56.3	22	11.3	10.7	72.4	.55	64	2.5	0	769	65q	85
Thatcher		10003	17.2	56.7	23	12.5	11.5	73.5	.50	60	2.0	0	768	70	90
Henry x Cadet		12781	25.6	59.6	27	12.8	11.7	75.7	.51	63	2.0	0	766	85	90
Lee		12488	20.1	60.4	27	13.1	12.2	74.6	.52	63	2.5	0	762	85	90
Rushmore <sup>2</sup> x Surpresa P.W.114			26.4	63.5	28	13.1	11.9	76.8	.51	58	1.5	0	759	85	90
Rushmore x Java P.W.112			26.5	63.4	27	12.1	11.5	77.2	.51	58	1.5	0	75.6	80	90
Pilot		11945	16.6	56.4	23	11.6	10.7	72.5	.54	60	2.0	0	748	75	85
Rushmore		12273	18.6	59.1	26	12.1	11.1	76.0	.51	61	2.5	0	740	85	90
Rushmore <sup>2</sup> x Surpresa P.W.36			26.2	61.5	37	14.6	12.9	72.5	.51	58	1.0	1	732	85	85
Rushmore x Java P.W.8			27.4	63.8	28	11.6	10.5	77.9	.49	58	1.0	0	716	70	80
1764 x Henry	2211	12733	19.8	56.7	23	10.8	10.0	71.4	.46	61	2.0	0	714	75	85
Mida		12008	14.4	57.7	24	11.3	10.5	74.5	.57	58	2.5	0	712	75	85
Average			20.4	59.3	27	12.4	11.5	74.8	.52	61	1.9	.06	770	79	87
Range			13.0	9.8	15	4.2	3.2	6.5	.15	7	1.5	1	143	25	10



Table 3.—Continued.

## Havre, Montana

Variety or Cross	State or N. No.	C. I. No.	Acre	Test Weight	Index	Pearl Value	Wheat Yield	Protein	Flour Yield	Ash	Absorp- tion	Mixing Time	Optimum Baking Methods		
													Bromate Volume	Color	Texture
			Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mg.	Cc.	Score
Thatcher			10003	23.0	59.0	25	15.8	14.6	72.7	.43	66	2.0	1	929	85
1764 x Henry	2211		12733	25.1	59.0	27	16.2	14.9	71.0	.43	66	2.0	2	923	85
Lee			12484	22.8	61.0	29	16.3	15.2	72.7	.44	68	2.5	1	918	95
Mida			12008	21.7	61.0	27	15.1	14.0	75.9	.44	68	2.0	1	864	90
Average			23.2	60.0	27	15.9	14.7	73.1	.44		67	2.1	1.25	909	89
Range			3.4	2.0	4	1.2	1.2	4.9	.01		2	.5	1.00	65	10

## Moccasin, Montana

Thatcher			10003	16.7	58.7	27	15.8	14.4	72.0	.38	66	2.5	0	915	85
1764 x Henry	2211		12733	16.3	57.5	26	17.3	15.9	71.2	.39	67	2.5	1	899	80
Lee			12484	15.4	58.9	32	16.4	15.0	71.7	.40	68	2.5	1	866	100
Average			16.1	58.4	28	16.5	15.1	71.6	.39		67	2.5	.67	893	88
Range			1.3	1.4	5	1.5	1.5	.8	.02		2	.0	1.00	49	20

MINNESOTA INTRASTATE PLOT COMPOSITE

The results from the Minnesota, intrastate plot composite (St. Paul, Waseca, Morris, and Crookston) are given in table 4.

Lee, considering the data as a whole, appears to be the best variety tested in this group. The loaf volume is less than for some others but color and texture scores are high. In contrast with results from many other stations the protein content of Lee is no higher than for many other varieties. Thatcher x Surpresa II-39-8 appears to be a good strain except possibly for its dough mixing time which is less than that of either Thatcher, Mida, or Lee. It milled very well with a high yield of flour, made satisfactory bread, and was low in flour ash content. The dough was slightly sticky (additional tests may not show this). A number of the Frontana x Thatchers look promising except for their very short dough mixing times; about half that of Thatcher or Mida. Strain II-46-13 appears to be the best of these for quality. Frontana x Thatcher II-46-3 was unsatisfactory in milling. The flour was soft and bolted slowly. All the Frontana x Thatcher strains made bread that was generally lower in loaf volume than expected on the basis of their flour protein contents.

Am<sup>10</sup> x Newthatch is one of the best in yield of flour, but otherwise is not outstanding.

Kentana had a low loaf volume and ranked lowest of the group in quality, although it was equal or higher in flour protein than many others. The bread from Henry x Cadet N. No. 2300 was fairly good especially considering the low protein content of the sample. Henry x Cadet N. No. 2233 is a promising strain. It is high in yield of flour and water absorption, has a good loaf volume, and very good bread grain and texture. The crumb color is low, averaging only slightly better than Thatcher, but considerably under Mida.

Table 4.—Yield, milling, baking and chemical results on hard red spring wheats grown in intrastate plots in 1952.

Minnesota Composite Plots 1/

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Variety or Cross	State or N. No.	C. I. No.	Acre	Test Weight	Yield	Pearl Index	Protein	Flour Yield	Ash	Pot.	Pot.	Absorp- tion	Mixing Time	Optimum Baking Method
				Lbs.	Pot.	Pot.	Pot.	Pot.	Pot.	Pot.	Pot.	Mg.	Min.	Cc. Score
Thatcher x Surpresa	II-39-8	12641		61.1	30	14.7	13.4	74.8	.42	62	62	1.5	1	887
Henry x Cadet	2233	12781		57.7	29	13.9	12.9	74.4	.47	65	65	2.0	2	887
Rushmore		12273		57.8	29	13.3	12.6	76.3	.47	65	65	3.0	1	864
Am10 x Newthatch	3662	12908		55.5	25	14.4	13.2	73.4	.50	66	66	1.5	2	863
Henry		12263		57.5	31	13.5	12.2	74.9	.48	62	62	1.5	1	847
Lee		12488		59.3	28	13.8	13.1	72.6	.46	66	66	2.5	1	845
Lee x 3175	3654	12507		57.8	28	13.5	12.8	74.5	.48	65	65	2.5	1	841
Rival		11708		56.2	24	13.1	11.9	74.7	.53	65	65	2.0	0	839
Frontana x Thatcher	II-46-53			58.3	36	16.1	14.8	72.7	.42	60	60	1.0	2	833q
Henry x Cadet	2239	12279		58.2	29	13.8	12.8	73.7	.47	65	65	2.0	1	831
Timstein x K 58	II-44-32			58.0	28	14.1	12.9	75.2	.43	63	63	1.5	2	828
Thatcher		10003		57.4	22	13.5	12.3	75.1	.50	64	64	2.0	1	825
Mida		12008		58.3	25	13.2	12.2	74.5	.49	63	63	2.0	1	810
Timstein x K 58	II-44-31	13028		57.2	28	14.7	13.4	75.9	.45	62	62	1.5	2	807
1764 x Henry	2211	12733		56.1	25	12.5	11.8	71.4	.44	63	63	2.0	1	794
Frontana x Thatcher	II-46-13	13030		59.8	36	14.9	13.8	71.6	.40	58	58	1.0	2	788q
Frontana x Thatcher	II-46-63			58.9	33	15.5	14.2	71.5	.43	58	58	1.0	1	785q
Frontana x Thatcher	II-46-5			58.4	35	16.4	15.1	72.0	.43	58	58	1.0	1	718u
Henry x Cadet	2300	12566		59.8	26	12.0	10.8	71.1	.43	62	62	1.5	1	714
Frontana x Thatcher	II-46-3	13029		59.8	40	15.6	13.5	71.4	.46	58	58	1.0	0	694u
Kentana	2856			59.0	41	14.3	12.5	72.2	.44	58	58	1.0	1	660u
Average				58.2	30	14.1	13.0	73.5	.46	62	62	1.7	1.19	808
Range				5.6	19	4.4	4.3	5.2	.13	8	8	2.0	2.00	227

1/ Data for acre yield not supplied from St. Paul, Waseca, Morris and Crookston stations.



## UNIFORM REGIONAL NURSERY

Two samples each of twenty-six wheats from the Uniform Regional Nursery have been tested for their milling, baking, and chemical properties. These consisted of a composite of grain from five Eastern stations and a composite of grain from five Western stations.

The results of the quality tests for the Eastern and Western composites and the average of both are shown in table 5. The data for varieties and strains are discussed first for the Eastern composites followed by the results for the Western composites.

### EASTERN COMPOSITE

In the Eastern Nursery Composite, Aml<sup>0</sup> x Newthatch N. No. 3780 has made the best bread, considering the data as a whole. The protein content was high although no higher than for many others. It had a slightly shorter dough mixing time than either Thatcher or Marquis. McMurachy Exchange x Redman<sup>3</sup> was highest in loaf volume and made bread that was good in grain and texture and crumb color. It milled satisfactorily and averaged 74.6 percent in flour yield. A number of the other crosses making good bread were Timstein x Mida II-42-89, Aml<sup>0</sup> x Newthatch N. No. 3894, Lee x N. No. 3175, Timstein x Henry II-44-65, Pilot x Thatcher N. No. 2170, Lee x Frontana N. No. 2357, Lee x Mida Sib and Henry x Cadet N. No. 2300. Frontana x Thatcher -13, made a loaf of bread having a satisfactory grain and texture and crumb color, but had a short dough mixing time. Frontana x Thatcher Nos. II-46-52 and II-46-3 made bread that was medium in crumb color and grain and texture, but also had a short dough mixing time and poor dough handling properties. The Frontana x Thatcher strains as a group averaged considerably shorter in dough mixing time than either Thatcher or Mida.

Rushmore<sup>2</sup> x Surpresa P.W.36 and P.W.114 also had short dough mixing times. This short mixing time is a definite objectionable characteristic. The bread from Timstein x Kenya 58, was the poorest.

A number of the samples produced a low yield of flour. These especially were Lee x Frontana N. No. 2357, Kenya 58 x Newthatch 29, Mida x Kenya 117A and Frontana x Thatcher II-46-3. Those samples that were poor in milling characteristics -- middlings hard to reduce and flour soft to the feel -- were Lee x Frontana N. No. 2357, Mida x Kenya 117A, Kenya 58 x Newthatch and Frontana x Thatcher II-46-3.

### WESTERN COMPOSITE

In the Western composite most of the samples made acceptable bread. Pilot<sup>2</sup> x Thatcher N. No. 2170, Henry x Cadet N. No. 2233, Aml<sup>0</sup> x Newthatch N. No. 3895, Timstein x Mida II-42-89, Lee x Ns 3175, N. No. 3654, Mida x Kenya 117A, II-44-22 and Aml<sup>0</sup> x Newthatch N. No. 3894 made the best bread, considering the data as a whole. A number of other samples made equally good bread but were deficient in dough handling properties, being weak and not quite as elastic or pliable. These were Lee x Mida Sib N. No. 3880,



Timstein x Kenya 58, II-44-31, and Frontana x Thatcher 13. The two other Frontana x Thatcher strains Nos. II-46-3 and II-46-52 and Rushmore<sup>2</sup> x Surpresa P.W.36 were also deficient in dough characteristics. It is of interest that the dough handling properties of Pilot<sup>2</sup> x Thatcher N. No. 2170 were strong and elastic and resembled that of Thatcher.

Frontana x Thatcher II-46-3, Rushmore<sup>2</sup> x Surpresa P.W.36, 1750 x 1753 N. No. 2256 Kenya 58 x Newthatch -29 and Frontana x Thatcher -52 made bread that was lower in loaf volume than expected from the protein content of the samples. The internal bread characteristics -- grain texture and crumb color -- were satisfactory. Timstein x Henry II-44-65 has made good bread and is similar in many respects to Marquis. Rushmore<sup>2</sup> x Surpresa P.W.114, and P.W.36, and Frontana x Thatcher Nos. -13, II-46-3 and -52 had considerably shorter dough mixing time than either Thatcher or Mida. A short dough mixing time such as found in these strains is a definite objectionable characteristic.

The bread from McMurachy Exchange x Redman<sup>3</sup> RL2624 was good. It was one of the better varieties in yield of flour. Henry x Cadet N. No. 2239, and Am<sup>10</sup> x Newthatch N. No. 3894 were also equally high in flour yield.

A number of samples produced a low yield of flour. These were Lee x Frontana N. No. 2357, Frontana x Thatcher II-46-13, Frontana x Thatcher II-46-3, Kenya 58 x Newthatch -29 and Frontana x Thatcher II-46-52. It is of interest that the Frontana x Thatcher strains as a group yielded about 8.0 percent less flour than Thatcher.

The samples showing poor milling characteristics were Lee x Frontana N. No. 2357, Rushmore<sup>2</sup> x Surpresa P.W.114, Frontana x Thatcher II-46-3, Frontana x Thatcher II-46-13, Frontana x Thatcher II-46-52, Mida x Kenya 117A and Kenya 58 x Newthatch -29. The middlings were difficult to reduce to flour and the flour was soft to the feel.

Table 5.--Yield, milling, baking and chemical results on 26 wheats grown in the Uniform Regional Nursery for the Eastern Composite, Western Composite, and the averages of the Eastern and Western Composites in 1952.

Eastern Composite 1/

Variety or Cross	State or N. No.	C. I. No.	Acre	Bu.	Lbs.	Test Weight	Pearling Index	Protein		Flour		Absorption	Mixing		Optimum Baking Method		
								Wheat	Flour	Yield	Ash		Time	Bromate	Loaf	Crumb	Grain
							Value	Pot.	Pot.	Pot.	Pot.	Pct.	Min.	Mg.	Co.	Score	Score
McMurray Exchange x Redman <sup>3</sup> RL 2624		12953	25.7	56.5	32	15.6	14.5	74.6	.53			64	2.0	3	942	90	90
Am10 x Newthatch 2/	Ns. 3780	12968	20.6	55.9	27	15.4	13.9	71.2	.53			65	1.5	1	925	100	95
Thatcher		10003	19.7	56.7	29	13.8	12.9	74.3	.53			63	2.0	0	913	85	90
Am10 x Newthatch 2/	Ns. 3662	12951	22.1	55.0	25	14.9	13.7	71.4	.54			65	1.5	2	899	85	90
Timstein x Mida	II-42-89	13027	20.5	58.3	34	14.9	13.8	74.7	.51			63	1.5	2	899	95	95
Am10 x Newthatch 2/	Ns. 3895	12971	20.1	54.2	25	14.4	13.4	70.2	.50			62	2.0	1	887	85	90
Am10 x Newthatch 2/	Ns. 3894	12970	21.2	55.3	25	14.5	13.2	70.6	.52			60	2.0	0	884	90	90
Henry x Cadet	N 2233	12781	25.6	57.5	29	14.7	13.5	74.2	.52			64	2.0	2	869	80	95
Frontana x Thatcher	II-46-13	13030	27.8	58.4	32	16.1	15.0	71.2	.54			60	1.0	3	868	95	95
Henry x Cadet	N 2229	12779	22.7	57.4	29	15.0	13.7	72.3	.52			65	2.0	2	853	80	95
Lee x M 3175	Ns. 3654	12907	24.2	57.5	26	14.7	13.6	71.6	.55			64	2.5	1	845	100	90
Timstein x Henry	II-44-65	13026	29.7	58.5	34	14.6	13.4	71.5	.48			62	1.5	2	845	95	95
Pilot <sup>2</sup> x Thatcher	N 2170	12974	20.1	56.8	25	13.4	12.4	71.7	.48			60	2.0	0	844	90	95
Rushmore <sup>2</sup> x Surpresa	P.V. 114	12973	23.3	61.1	28	14.1	12.8	74.4	.48			60	1.25	0	838	85	90
Lee x Frontana	N 2357	12957	25.5	60.2	34	14.7	13.4	67.3	.48			63	2.0	0	825	90	90
Lee x Mida Sib.	Ns. 3880	12976	22.9	57.8	27	15.5	13.9	70.3	.55			63	1.5	1	823	95	90
Marquis		3641	16.2	56.6	28	13.5	12.5	72.1	.54			62	2.0	1	820	85	90
1750 x 1753	N 2256	12975	19.1	57.5	24	13.7	12.5	70.4	.53			60	2.5	0	818	90	85
Kenya 58 x Newthatch	II-44-29	13032	20.0	57.3	32	14.5	13.2	66.4	.50			60	1.5	3	788	75	80
Henry x Cadet	N 2300	12966	25.9	57.3	27	13.7	12.5	72.6	.52			63	1.5	1	785	95	90
Timstein x Kenya 58	II-44-31	13028	22.3	56.1	28	15.4	14.0	72.7	.46			62	1.5	0	785	60u	65q
Am10 x Newthatch 2/	Ns. 3681.5	12969	24.7	58.0	24	13.1	12.1	72.6	.48			60	2.0	1	779	85	90
Frontana x Thatcher	II-46-52	13031	23.8	57.6	30	16.5	15.4	71.9	.47			60	1.0	0	751	80	80
Rushmore <sup>2</sup> x Surpresa	P.V. 36	12972	26.0	60.1	36	15.1	13.3	70.9	.51			58	1.0	0	743	80	75
Mida x Kenya 117A	II-44-22	12964	22.4	59.0	32	15.0	13.6	68.4	.51			58	1.5	0	740	85	85
Frontana x Thatcher	II-46-3	13029	26.4	58.9	37	16.4	14.6	68.1	.54			58	.75	0	726	85	75
Average			23.0	57.5	29	14.7	13.5	71.4	.51			62	1.67	1.00	834	87	88
Range			13.5	6.1	13	3.4	3.3	8.3	.08			7	1.75	3.00	202	40	30

1/ Average of five stations Fargo, Morris, Madison, St. Paul and Brookings.

2/ [(Timopheevi-Ae. squarrosa x Ill. 1-Chinese)2 x Ns. 3144] x Newthatch.

Table 5.—Continued

## Western Composite 1/

Variety or Cross	State or N. No.	C. I. No.	Acres	Test Weight	Pearl-Index	Protein		Flour		Absorp-tion	Mixing		Optimum Baking Method		
						Pot.	Pot.	Yield	Pot.		Time	Time	Leaf Volume	Crumb Color	Grain Texture
			Bu.	Lbs.	Value	Pot.	Pot.	Pot.	Pot.	Pot.	Min.	Min.	Mg.	Score	Score
Thatcher		10003	19.4	60.1	29	15.4	14.2	73.9	.44	64	2.0	0	966	80	95
Pilot <sup>2</sup> x Thatcher	N 2170	12974	25.1	59.7	27	15.3	14.2	71.7	.38	63	2.0	0	958	95	90
Henry x Cadet	N 2239	12779	22.5	58.9	29	15.6	14.7	75.4	.44	67	2.0	1	956	75	95
Henry x Cadet	N 2233	12781	19.7	58.8	29	15.4	14.6	72.9	.44	66	2.0	2	953	95	95
Lee x Frontana	N 2357	12957	20.1	61.4	35	16.1	15.2	65.8	.42	65	2.0	1	940	75	90
Am <sup>10</sup> x Newthatch 2/	Ns. 3895	12971	19.1	58.4	29	15.8	14.7	73.6	.41	64	2.0	0	940	100	95
Timstein x Mida	II-42-89	13027	19.4	60.0	34	15.1	14.1	72.6	.40	64	1.5	1	935	90	95
Lee x Ns. 3175	Ns. 3654	12907	18.7	60.1	29	15.8	14.7	73.6	.44	65	2.0	1	929	95	90
Am <sup>10</sup> x Newthatch 2/	Ns. 3780	12968	18.2	59.4	29	15.5	14.4	72.7	.40	65	1.5	1	929	100	85
Am <sup>10</sup> x Newthatch 2/	Ns. 3894	12970	20.0	59.0	29	15.6	14.4	75.2	.42	65	2.0	1	925	90	90
Marquis		3641	19.1	60.3	28	15.0	13.8	70.7	.45	63	2.0	0	918	85	90
McMurachy Exchange x Redman <sup>3</sup>	RL2624	12953	19.3	58.1	30	15.4	14.6	75.2	.44	64	2.0	1	912	85	95
Rushmore <sup>2</sup> x Surpresa	P.W.114	12973	21.3	62.7	29	15.1	14.0	69.8	.40	62	1.25	1	911	80	95
Lee x Mida Sib.	Ns. 3880	12976	19.2	61.0	31	16.0	14.9	73.8	.43	66	1.5	1	887	95	95
Timstein x Kenya 58	II-44-31	13028	17.9	59.0	28	15.6	14.5	72.3	.38	64	1.5	3	884	95	95
Am <sup>10</sup> x Newthatch 2/	Ns. 3662	12951	18.6	57.8	28	16.1	14.9	73.6	.44	65	1.5	1	849	80	90
Henry x Cadet	N 2300	12966	20.9	59.6	28	15.1	14.1	72.3	.44	65	2.0	1	848	80	90
Timstein x Henry	II-44-65	13026	21.7	59.5	32	15.1	14.1	71.4	.42	62	1.5	2	844	80	90
Am <sup>10</sup> x Newthatch 2/	Ns. 3681.5	12969	20.9	60.6	26	14.2	13.0	73.5	.41	63	1.5	1	838	80	90
Frontana x Thatcher	II-46-13	13030	19.9	59.1	31	16.4	15.5	65.6	.38	60	1.0	0	830	90	95
Mida x Kenya 117A	II-44-22	12964	17.3	60.5	31	16.1	15.1	69.8	.47	60	1.5	1	830	95	90
Frontana x Thatcher	II-46-3	13029	19.2	59.5	35	16.4	14.7	66.1	.41	60	.75	1	797	85	95
Rushmore <sup>2</sup> x Surpresa	P.W.36	12972	19.5	61.0	35	15.3	14.0	70.9	.42	61	1.0	1	797	80	90
1750 x 1753	N 2256	12975	21.7	60.9	26	14.8	13.7	72.5	.41	60	2.5	0	791	85	90
Kenya 58 x Newthatch	II-44-29	13032	19.1	57.8	30	15.4	14.6	65.6	.49	60	1.5	2	782	75	85
Frontana x Thatcher	II-46-52	13031	18.6	58.7	30	17.0	16.3	69.0	.40	60	1.0	0	778	85	85
Average			19.9	59.5	30	15.6	14.5	71.5	.42	63	1.65	.92	882	87	92
Range			7.8	4.9	9	2.8	3.3	9.8	.11	7	1.75	3.00	188	25	10

1/ Average of five western stations - Havre, Alliance, Dickinson, Moccasin and Minot.

2/ [(Timopheevi-Ae. squarrosa x Ill. 1-Chinese)<sup>2</sup> x Ns. 3144] x Newthatch.



Table 5.--Continued

## Average of the Eastern and Western Composites

Variety or Cross	State or N. No.	C. I. No.	Acres	Yield: Bu.	Test Weight: Lbs.	Pearl- Index: Value	Protein		Flour		Ash	Absorp- tion		Time	Optimum Baking Method		
							Wheat	Flour	Yield	Pot.		Pot.	Min.		Mg.	Co.	Score
Thatcher	RL2624	10003	19.6	58.4	29	14.6	13.6	74.1	.49	64	2.0	.00	940	83	93		
McMurachy Exchange x Redman <sup>3</sup>	12953	22.5	57.3	31	15.5	14.6	74.9	.47	64	2.0	2.00	927	88	93			
Am10 x Newthatch 1/	Ns. 3780	12968	19.4	57.7	28	15.5	14.2	72.0	.47	65	1.5	1.00	927	100	90		
Timstein x Mida	II-42-89	13027	20.0	59.2	34	15.0	14.0	73.7	.46	64	1.5	1.50	917	93	95		
Am10 x Newthatch 1/	Ns. 3895	12971	19.6	56.3	27	15.1	14.1	71.9	.46	63	2.0	.50	914	93	93		
Henry x Cadet	N 2233	12781	22.7	58.2	29	15.1	14.1	73.6	.48	65	2.0	2.00	911	88	95		
Henry x Cadet	N 2239	12779	22.6	58.2	29	15.3	14.2	73.8	.48	66	2.0	1.50	905	78	95		
Am10 x Newthatch 1/	Ns. 3894	12970	20.6	57.2	27	15.1	13.8	72.9	.47	63	2.0	.50	905	90	90		
Pilot <sup>2</sup> x Thatcher	N 2170	12974	22.6	59.3	26	14.4	13.3	71.7	.43	62	2.0	.00	901	93	93		
Lee x Ns. 3175	Ns. 3654	12907	21.5	58.8	28	15.3	14.2	72.6	.50	65	2.25	1.00	887	98	90		
Lee x Frontana	N 2357	12957	22.3	60.8	35	15.4	14.3	66.6	.45	64	2.0	.50	883	83	90		
Rushmore <sup>2</sup> x Surpresa	P.W.114	12973	22.3	61.9	29	14.6	13.4	72.1	.44	61	1.25	.50	875	83	93		
Am10 x Newthatch 1/	Ns. 3662	12951	20.4	56.4	27	15.5	14.3	72.5	.49	65	1.5	1.50	874	83	90		
Marquis	3641	17.7	58.5	28	14.3	13.2	71.4	.50	63	2.0	.50	869	85	90			
Lee x Mida Sib.	Ns. 3880	12976	21.1	59.4	29	15.8	14.4	72.1	.49	65	1.5	1.00	855	95	93		
Frontana x Thatcher	II-46-13	13030	23.9	58.8	32	16.3	15.3	68.4	.46	60	1.0	1.50	849	93	95		
Timstein x Henry	II-44-65	13026	25.7	59.0	33	14.9	13.8	71.5	.45	62	1.5	2.00	845	88	93		
Timstein x Kenya 58	II-44-31	13028	20.1	57.6	28	15.5	14.3	72.5	.42	63	1.5	1.50	835	78	80		
Henry x Cadet	N 2300	12966	23.4	58.5	28	14.4	13.3	72.5	.48	64	1.75	1.00	817	88	90		
Am10 x Newthatch 1/	Ns. 3681.5	12969	22.8	59.3	25	13.7	12.6	73.1	.45	62	1.75	1.00	809	83	90		
1750 x 1753	N 2256	12975	20.4	59.2	25	14.3	13.1	71.5	.47	60	2.5	.00	805	88	88		
Mida x Kenya 117A	II-44-22	12964	19.9	59.8	32	15.6	14.4	69.1	.49	59	1.5	.50	785	90	88		
Kenya 58 x Newthatch	II-44-29	13032	19.6	57.6	31	15.0	13.9	66.0	.50	60	1.5	2.50	785	75	83		
Rushmore <sup>2</sup> x Surpresa	P.W.36	12972	22.8	60.6	36	15.2	13.7	70.9	.47	60	1.0	.50	770	80	83		
Frontana x Thatcher	II-46-52	13031	21.2	58.2	30	16.8	15.9	70.5	.44	60	1.0	.00	765	83	83		
Frontana x Thatcher	II-46-3	13029	22.8	59.2	36	16.4	14.7	67.1	.48	59	.75	.50	762	85	85		
Average		21.4	58.7	30	15.2	14.0	71.5	.47	63	1.66	.96	858	87	90			
Range		8.0	5.6	11	3.1	3.3	8.9	.08	7	1.75	2.50	178	25	15			

1/ [(Timopheevi-Ae. squarrosa x Ill. 1-Chinese)<sup>2</sup> x Ns. 3144] x Newthatch.



### STATE NURSERY TRIALS

Results for the Havre and Moccasin, Montana, composite, the Choteau, Montana, samples and the Madison, Wisconsin, samples grown in nursery trials are shown in table 6.

#### HAVRE AND MOCCASIN, MONTANA, COMPOSITE

The thirty-five Havre and Moccasin composite samples include many strains of current interest. The protein contents were high; the dough properties were generally strong; and the water absorption was good. All the wheats made bread that was satisfactory.

One of the principal interests in these tests is a comparison of the quality of the strains which included Rescue in their parentage with the quality of Thatcher and Rescue. These strains have been evaluated, considering the data as a whole, and grouped into three classes as follows:

- 1st - 1750 x Rescue, B-50-120  
Rescue x Thatcher, B-50-18  
Rescue x Th.- S615 - B-51-37
- 2nd - Rescue x 1831, B-51-9  
Rescue x Th.- S615, B-51-27  
1764 x Rescue B-49-78  
Rescue x Th.- S615, B-51-39  
Rescue x Th.- S615, B-51-16
- 3rd - These are the ones with questionable  
milling properties  
Rescue x Th.- S615, B-51-43  
1764 x Rescue, B-49-90  
1750 x Rescue B-49-102

The samples in group 1 are about equal to Thatcher and better than Rescue. Group 2 is not as good as Thatcher but about equal to Rescue. Those in group 3 are poorer in milling (principally because of slow bolting) than either Thatcher or Rescue but otherwise have made satisfactory bread generally equal to Rescue.

A discussion of some of the other wheats from the Moccasin and Havre composite are as follows:

A number of these samples showed questionable milling properties. Those fair in milling - principally because of slow bolting - were: 1912 x 1898, 1533A-1-12-1-1, 2014 x 3175, N. No. 2387, 1947 x 2044, N. No. 2413, Lee x 1912-1898, N. No. 2406, and 1898 x Lee, 1536A-5-4-1-1. Lee x Frontana, N. No. 2410, and 1691 x 1756, N. No. 2035-1, were rated as good in milling. These two varieties bolted somewhat slowly, a property that may or may not be found if additional samples were tested. The rest of the samples milled satisfactorily.

It will be noted that a number of the samples produced a high percent of flour (74.0 percent or more).

Red Thatcher was 111 cc. lower in loaf volume, than expected, from the protein content of the flour. Pilot<sup>2</sup> x Merit N. No. 2164 and Rescue both were higher in loaf volume, considering their protein contents. The rest of the varieties and strains produced satisfactory loaf volumes.

There were a number of excellent bread baking strains among these wheats. Those that appear best considering the data as a whole are: Lee 1520 x 1752, N. No. 2389 and 1919 x 2041, 1512A-2-1-1-2. These are considered equal to or better than Thatcher and Rescue except for loaf volume. Rescue produced a better than average loaf volume for its protein content. Lee x Frontana, N. No. 2410 made good bread. It was not quite as good as Thatcher or Rescue.

Those samples that were second best considering the data as a whole are: Pilot<sup>2</sup> x Merit, N. No. 2164, 1750 x 1753, N. No. 2256 and 1552 x Mida, C. I. 12746, Rushmore and Thatcher. These samples are better than Rescue except for loaf volume which appears to be better than normal, as already mentioned.

A number of other strains of good bread-baking properties, but of questionable milling quality are 2014 x 3175, N. No. 2387; and Lee x 1912-1898, N. No. 2406.

The strain 1764 x Henry, N. No. 2211 made good bread and appears on the basis of these tests to be equal to Thatcher and better than Rescue. It has shown good performance in our tests on samples from other stations and is one of the more promising strains tested in recent years.

#### CHOTEAU, MONTANA

The Choteau, Montana, nursery samples as a group averaged generally better in quality than the Havre-Moccasin, Montana composite. All the samples made satisfactory bread.

A number of the Choteau samples showed questionable milling properties. These rating only fair in milling - principally because the middlings were tough, hard and difficult to reduce to flour - were 1750 x Rescue, B50-120; Rescue x Th.-S615, B51-16; 1840 x Rescue, Dick.96; and 1750 x Rescue, B49-102. All the others were satisfactory in milling with a number of them producing 76.0 percent or more in flour yield.

All produced good loaf volumes in respect to the flour protein content of the samples. A number of the samples produced higher loaf volumes than expected on this basis. The doughs were strong and elastic and of satisfactory quality. Mida x Rescue, Dickson 46 was possibly the strongest of the wheats in dough properties, being slightly better than the other samples.

All these samples have made acceptable bread, but the following seem to be the best. Mida x Rescue, Dick. 93; Mida x Reseue, Dick. 89; Wis. 240 x Rescue, Dick. 94; Rescue x Th.- S615, B51-39; 1764 x Rescue, B49-90; and Thatcher x S615, H4258.

It will be noted that these are best in crumb color, grain and texture and satisfactory in milling quality as well as loaf volume. The last two of these required 67.0 percent water absorption and were highest of the group in this respect. These are equal to Thatcher and better than Rescue considering the quality data as a whole. Strain 1750 x Rescue, B50-120 made good bread, but was questionable in milling quality. It was slightly lower in crumb color than Thatcher. It was equal to Rescue in bread characteristics.

Rescue x Th.-Sel 615, B51-16; and 1750 x Rescue, B49-102 are perhaps the poorest of the group, being low in bread characteristics (crumb color and grain and texture) and deficient in milling quality. These two have also been lowest in yield of flour among the samples. Strain B49-102 has produced a slightly higher loaf volume than expected for its flour protein content.

Strain 1840 x Rescue Dick. 96 milled fair. It was one of the better ones in bread properties but somewhat deficient in milling quality.

#### MADISON, WISCONSIN

The grain from a number of the nursery samples from Madison, was badly weathered. This affected the milling characteristics more than the baking.

Strain H405C-7-1-1-3, considering the data as a whole, made the best bread of the four strains tested. Strain H305-10 was a close second. Both of these produced a reasonably good yield of flour for their test weights and the flour made satisfactory bread. The dough properties were slightly weak in the make-up, but still considered strong enough to be acceptable for bread. Strain H306 was one of the better ones in water absorption of flour, crumb color and grain and texture of bread, but deficient in yield of flour. Strain H306 was the same or higher in flour protein content than either Thatcher or Henry, but much lower in loaf volume than either of the named varieties.

Strain H405C-7-1-1-1 made the poorest bread of those tested. It appears to be deficient in yield of flour, loaf volume of bread, and lowest in bread crumb color of the samples. It is considered on the basis of this one test as having only the minimum bread quality characteristics for acceptability.

It should be pointed out that strain H 405C-7-1-1-1 was higher in protein content than either Thatcher or Henry, but much lower in loaf volume than either of them.





Table 6.—Continued

Havre and Moccasin, Montana 1/

Variety or Cross	State or N. No.	C. I. No.	Acres	Yield: Weight	Test: Index	Pearl:		Protein	Flour		Absorp- tion	Mixing: Time	Optimum Baking Method	
						Pct.	Pct.	Pot.	Pot.	Pot.	Pot.	Min.	Mg.	Score
1520 x 1752				62.8	28			15.6	14.9	75.8	.43	1.5	1	939
Rushmore				60.5	31			15.7	14.9	72.9	.42	3.0	1	937
1750 x 1753				62.1	26			16.2	15.3	72.5	.45	2.0	1	934
Thatcher x S615				61.9	30			15.6	15.3	71.8	.40	2.5	1	934
Lee				60.5	31			16.4	15.6	69.1	.43	2.5	1	934
Rescue x Th.-S615				62.3	28			16.6	16.0	71.8	.44	2.5	1	922
1750 x Rescue				61.3	30			15.5	14.4	71.1	.45	1.5	1	917
Rescue x Th.S615				61.2	29			15.6	15.4	69.9	.49	3.0	1	916
Lee x 1912-1898				61.2	28			15.9	15.1	71.7	.56	3.0	1	910
1691 x 1756				62.1	26			15.3	14.9	74.5	.50	1.5	1	908
1947 x 2044				61.4	28			14.6	14.1	69.6	.47	2.5	1	871
Red Thatcher				61.7	30			15.7	15.3	70.6	.45	2.0	0	859
Average				61.1	28			16.1	15.4	71.8	.47	2.2	1.37	971
Range				5.7	14			2.5	3.0	7.8	.14	1.5	3.0	257

1/ Data for acre yield not supplied

Choteau, Montana 1/

Mida x Rescue	Dick. 46	62.3	38	17.0	16.7	73.3	.45	65	2.0	1	1061	85	85
1840 x Rescue	Dick. 96	60.4	41	16.9	16.3	72.9	.51	63	1.5	2	1030	90	90
2157 x Rescue	Dick. 76	61.0	37	15.9	15.4	76.7	.53	66	2.5	2	1015	85	80
Thatcher		61.5	35	15.7	15.1	75.1	.47	66	2.0	1	1009	90	90
Mida x Rescue	Dick. 93	62.3	38	15.5	15.0	76.1	.50	64	1.5	1	1001	90	90
Mida x Rescue	Dick. 89	62.3	36	16.3	15.6	75.3	.45	64	2.0	1	989	95	90
Wis. 240 x Rescue	Dick. 94	60.9	36	15.3	14.7	75.9	.45	66	2.0	1	974	95	90
Rescue x Th.-S615	B-51-39	62.3	41	16.1	15.5	74.5	.46	65	2.0	1	965	90	90
2157 x Rescue	Dick. 75	61.2	35	15.3	14.6	74.9	.46	66	2.5	1	965	90	85
Rescue		61.6	38	14.7	14.2	73.9	.44	63	2.0	1	959	85	90
1750 x Rescue	B-49-102	61.9	37	15.3	14.5	71.9	.46	63	2.0	1	954	80	85
1764 x Rescue	B-49-90	61.7	31	16.0	15.6	76.2	.54	67	2.5	2	951	90	90
2157 x Rescue	Dick. 81	63.6	38	15.6	14.8	74.1	.44	66	2.0	1	951	85	85
Rescue x Th.-S615	B-51-37	62.4	37	16.4	16.1	73.1	.48	63	2.0	2	945	90	85
Thatcher x S615	H-42-58	62.6	38	16.2	15.8	72.3	.43	67	2.0	2	943	90	90
Rescue x 1831	B-51-9	62.2	37	14.5	14.2	76.5	.45	64	2.0	1	942	80	90
2157 x Rescue	Dick. 79	61.8	36	15.6	14.9	75.3	.46	64	2.0	1	937	80	85
1750 x Rescue	B-50-120	61.0	35	16.4	15.6	72.0	.56	62	1.5	2	922	85	90
Rescue x Th.-S615	B-51-16	62.3	34	15.6	15.2	69.3	.50	65	2.0	1	889	85	85
Rescue x Th.-S615	B-51-43	62.6	34	15.6	15.0	73.8	.48	65	2.0	2	883	85	85
Average		61.9	37	15.8	15.2	74.2	.48	65	2.0	1.35	964	87	88
Range		3.2	10	2.5	2.5	7.4	.13	5	1.0	1.00	178	15	10

SUPPLEMENTARY HARD RED SPRING  
REGIONAL YIELD NURSERY

Three new strains and Mida and Thatcher from the Supplementary Hard Red Spring Regional Yield Nursery were tested for milling, baking, and chemical properties. A composite of grain from eight stations was made as indicated in a footnote to table 7.

Frontana x Thatcher II-46-53 made bread having the best crumb color and grain and texture. It was high in water absorption and flour yield, and low in flour ash. The loaf volume of the bread was lower than expected from the protein content of the sample. This indicates that the gluten properties of Frontana x Thatcher are weaker than those of the comparably grown Thatcher and Mida. Rushmore x Surpresa P.W.114 made satisfactory bread considering the data as a whole. It was the best of the two Rushmore x Surpresa selections, exceeding P.W.36 in loaf volume, grain and texture. The dough handling properties of P.W.36 were weak and the loaf volume was lower than expected for the protein content of the samples. All the samples from this nursery milled satisfactorily.



Table 7.--Yield, milling, baking and chemical results on hard red spring wheats grown in the supplementary regional yield nursery 1952 crop. 1/

Regional Nursery

Variety or Cross	State or N. No.	C. I. No.	Acres Yield	Test Weight	Pearl- ing Index	Protein	Flour Yield	Ash	Absorp- tion		Mixing Time		Pot.		Optimum Baking Method	
			Bu.	Lbs.	Pct.	Pot.	Pct.	Pot.	Pct.	Pct.	Min.	Pot.	Pct.	Pct.	Score	Score
Thatcher		10003	11.5	52.0	21	13.8	12.9	71.1	.49	60	2.0	1	881	80	95	
Rushmore2 x Surpresa P.W.114			21.1	60.2	26	14.7	13.6	73.1	.47	60	1.0	1	855	85	95	
Frontana x Thatcher	II-46-53		23.9	57.8	33	16.6	15.4	72.2	.43	62	1.0	1	842q	95	95	
Mida		12008	13.0	55.2	22	13.4	12.3	71.2	.49	60	2.0	1	791	85	90	
Rushmore2 x Surpresa P.W.36			22.0	59.5	35	15.1	13.4	70.3	.47	50	1.0	0	732q	70	70	
Average			18.3	56.9	27	14.7	13.5	71.6	.47	60	1.4	.80	820	83	89	
Range			12.4	8.2	14	3.2	3.1	2.8	.06	2	1.0	1.00	149	25	25	

1/ St. Paul, Morris, Crookston, Minot, Fargo, Edgeley, Madison and Brookings stations

SPECIAL FOREIGN VARIETIES AND STRAINS

Results for ten varieties and strains from Portugal originally but grown at Choteau, Montana, are shown in table 8. They are of interest because of their possible use as parents in crosses to obtain resistance to wheat stem saw fly. Thatcher and Rescue were included for comparison. The varieties and strains are discussed largely on a consideration of the quality data as a whole with additional remarks about some of the individual properties of the wheats.

Lobeiro x Ribeiro, 56227-1 and Ribeiro, 56206-11 were best of these strains. They were equal in quality to Rescue, but not so strong as Thatcher which was rated best in these tests. Both of these strains milled satisfactorily and the doughs were of good quality being elastic and pliable. Lobeiro x Barbella, 56225-10 was next best and slightly better than Barbella and Barbella x Santa Martha. The latter two strains were lower in loaf volume than expected for their protein content. The dough of Barbella x Santa Martha was slightly weak and sticky. Amarello de barba branca x Ribeiro was questionable in milling quality, satisfactory in dough properties, lower than expected in loaf volume, but made bread generally considered satisfactory in crumb color and grain and texture. It was excessively high in flour ash, greatly exceeding Thatcher and Rescue in this respect. In yield of flour, it averaged about the same as Ribeiro, but was considerably lower than a number of the other strains which yielded 5.0 to 7.0 percent more flour. The size of a number of the samples in this study was small (including this strain) which may account, in part, for some of the low flour yields.

Lobeiro x Barbella Nos. 56225-4 and 56225-12 made bread that was deficient in loaf volume and low in crumb color and grain and texture. The dough properties of both were slightly weak. Ribeiro 56206-3 made bread that was low in loaf volume and poor in crumb color. The milling properties of Ribeiro were poor - middlings tough and hard to reduce to flour - and the flour ash excessively high.

Lobeiro x Barbella No. 56225-8 made unsatisfactory bread and was the poorest of the samples tested. It was, however, one of the better strains in yield and flour along with Barbella x Santa Martha, showing 77.1 and 77.7 percent, respectively.

Table 8.--Yield, milling, baking and chemical results on special foreign varieties and strains 1952 crop.

Choteau, Montana 1/

Variety or Cross	C. I. or P. I. No.	Acre	Yield: Lbs.	Test: Index	Pearl: Value	Protein: Wheat	Flour: Flour	Absorp- tion	Mixing: Time	Min.	Mg.	Optimum Baking Method		
												Moisture	Crumb	Grain
												Promote: Volume	Color	Texture
						Pct.	Pct.	Pct.	Pct.	Pct.		Co.	Score	Score
Thatcher	10003		61.5			13.9	13.5	74.5	.47	62	3.0	1	836	95
Rescue	12435		62.3			13.2	12.8	75.2	.51	58	2.0	1	778	90
Ribeiro	56206-11		62.3			15.0	13.9	71.3	.55	57	1.5	1	786	90
Lobeiro x Ribeiro	56227-1		61.1			14.1	13.7	75.2	.55	60	1.5	1	763	85
Lobeiro x Barbella	56225-10		60.2			14.4	14.1	75.6	.57	60	1.5	1	807	80
Barbella x Santa Martha	56222-9		63.2			13.5	12.8	77.7	.57	58	1.0	1	677q	75
Barbella	7009		61.5			15.3	14.6	72.6	.59	58	1.5	1	738u	75
Amarello de barba branca x Ribeiro	56219-7		61.2			16.3	15.3	70.5	.75	56	1.5	1	792q	85
Lobeiro x Barbella	56225-12		59.7			13.9	13.4	72.7	.54	58	1.0	1	723q	70
Lobeiro x Barbella	56225-4		59.7			14.5	14.1	75.4	.56	58	1.0	1	732u	60u
Ribeiro	56206-3		62.4			14.0	13.6	72.0	.72	61	1.5	1	698u	75
Lobeiro x Barbella	56225-8		59.8			14.0	13.8	77.1	.53	58	1.0	1	704u	55u
Average			61.2			14.3	13.8	74.2	.58	59	1.5	1.00	753	80
Range			3.5			3.1	2.5	7.2	.28	6	2.0	.0	159	25

1/ Data for acre yield not supplied and pearling index not determined.



### FERTILIZER EXPERIMENTS

The results for the samples grown at Bozeman, Montana, in two special fertilizer trials are shown in table 9.

Seven varieties in the first study were grown at Bozeman, Montana, under irrigation each with 0, 50 and 100 pounds of nitrogen applied per acre. The application of 50 and 100 pounds of nitrogen greatly increased the yields. As a result of increased yields per acre the application of 50 pounds of nitrogen decreased the protein content of Thatcher, Pilot, Lee, Ceres, Rescue and 1764 x Henry and only slightly increased that of Supreme and 1764 x Rescue. The 100 pound treatment resulted in an increase only in Supreme and 1764 x Rescue.

The loaf volumes of the bread correlate, in general with the protein contents indicating that there is no very marked effect on the gluten characteristics of the samples for the different treatments. Pilot and 1764 x Henry showed the greatest differences in loaf volume for the soil treatments, but none of these differences were considered highly significant. Considering the loaf volume, crumb color and the grain and texture. Thatcher and Lee were affected least by the nitrogen treatment.

In a second study, 15 samples of Thatcher grown at Bozeman, Montana, under irrigation were treated with urea sprays (foliar) and ammonium nitrate, added to the soil, during different stages of growth.

The early application of the foliar treatment increased the acre yields while later applications had no effect on yield. The first date of application to the soil also increased materially the acre yields while the latter date had no effect. The first 4 foliar treatments increased the protein content significantly while the July 23 treatment gave some increase. The soil treatment on May 29 had no effect on protein content but the one on June 23 greatly increased it.

For the most part the loaf volumes of the bread were about that expected for the protein content of the samples.

There has been some improvement in the test weight of the samples by the different treatments. In some instances the increase was as much as 1.6 pounds. Time of application of the treatments did not appear to have a consistent effect on test weight, although the early foliar treatment showed slightly higher weights than the later dates.

Table 9.--Yield, milling, baking and chemical results on hard red spring wheats grown in fertilizer trials 1952 crop.

Bozeman, Montana 1/

Variety or Cross	State or N. No.	C. I. Acre No.	Pearl- ing	Test Weight	Yield	Index	Protein	Flour	Absorp- tion	Mixing Time	Mg.	Cc.	Score	Optimum Baking Method
				Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.			Loaf :Crumb: Grain Bromate :Volume:Color:Texture
1764 x Henry Check	N 2211	12733	21.1	62.1	11.2	10.4	72.3	.50	65	1.5	0	686	75	80
Thatcher Check		10003	20.6	62.9	11.4	10.5	66.4	.46	62	2.0	0	651	80	75
1764 x Henry 100 lbs. N.	N 2211	12733	50.5	62.7	10.6	10.0	76.1	.51	66	1.5	0	640	70	75
1764 x Rescue Check	B-49-90		30.0	63.1	9.6	8.9	76.4	.53	63	2.0	0	622	75	70
1764 x Rescue 50 lbs. N.	B-49-90		42.4	62.8	9.9	8.9	75.0	.54	65	2.0	0	611	65q	70
Thatcher 100 lbs. N.		10003	49.4	62.9	10.1	9.0	75.2	.54	65	2.5	0	600	75	75
1764 x Henry 50 lbs. N.	N 2211	12733	42.9	62.7	10.0	9.3	75.2	.49	67	1.5	0	600	65q	65q
1764 x Rescue 100 lbs. N.	B-49-90		53.4	63.0	10.1	9.4	75.0	.53	65	2.0	0	592	70	65q
Rescue 100 lbs. N.		12435	51.5	63.3	9.7	8.8	75.1	.50	58	1.5	0	589	65q	65q
Pilot Check		11945	24.5	62.6	9.6	9.1	71.7	.46	60	1.5	0	586	80	70
Lee Check		12488	22.4	62.9	10.7	9.6	71.1	.45	64	2.0	0	586	80	70
Lee 100 lbs. N.		12488	51.1	63.2	10.2	9.6	72.3	.49	65	2.0	0	586	75	70
Supreme 50 lbs. N.		8026	43.6	61.6	8.6	7.8	73.5	.53	65	2.0	0	586	70	65q
Thatcher 50 lbs. N.		10003	35.9	62.5	9.7	8.9	71.6	.51	66	2.5	0	578	70	70
Rescue Check		12435	25.7	62.9	9.5	8.7	73.3	.50	58	1.5	0	574	65q	60q
Supreme Check		8026	28.6	61.8	8.5	7.7	72.3	.56	64	2.0	0	559	65q	60q
Supreme 100 lbs. N.		8026	52.3	62.2	9.4	8.5	72.5	.52	65	2.0	0	551	65q	65q
Lee 50 lbs. N.		12488	39.9	63.0	9.7	8.8	72.4	.48	66	2.5	1	549	80	70
Rescue 50 lbs. N.		12435	41.5	62.9	9.1	8.3	73.7	.49	58	1.5	0	549	60q	60q
Pilot 100 lbs. N.		11945	59.6	62.6	9.7	8.6	73.9	.40	61	1.5	0	530	70	60q
Ceres 100 lbs. N.		6900	52.0	62.5	9.4	8.5	75.5	.53	62	2.0	0	530	60q	60q
Ceres 50 lbs. N.		6900	39.8	61.9	9.1	8.1	73.7	.47	62	2.0	0	522	55u	55u
Ceres Check		6900	24.4	62.6	9.9	8.8	69.3	.50	61	2.0	0	495	60q	55u
Pilot 50 lbs. N.		11945	42.9	62.0	9.2	8.0	74.3	.47	62	1.5	1	487 q	70	60q
Average			39.4	62.6	9.8	8.9	73.2	.50	63	1.9	.08	577	69	66
Range			39.0	1.7	2.9	2.8	10.0	.16	9	1.0	1.00	199	25	25

1/ Data for pearling index not determined.

## Bozeman, Montana

- 1/ Three pounds of urea per gallon of water (half-saturated) and applied as a spray on the foliage.
- 2/ Ammonium nitrate applied in dry form.



### COMMERCIAL SAMPLES

As in past years, a number of commercially grown wheat samples were obtained through the Grain Branch, Production and Marketing Administration, for comparison with the varieties and strains produced in experimental plots. Fifteen such samples, representing a number of grades and types, were obtained at Great Falls, Mont.; and Minneapolis and Duluth, Minn. The samples were composited by grade from 4,400 cars of wheat grading No. 3 or better. This is the fourteenth season such samples have been tested. The results are given in table 10.

These samples generally averaged lower in protein content than the varieties and strains grown in experimental plot and nursery trials. The Great Falls, Mont., samples averaged highest in protein content and Minneapolis, Minn., samples lowest. The commercial samples of the Subclass Northern Spring (N.S.) appear as a group to be best in flour yield as based on their test weights. The milling characteristics were much alike for the commercial and experimental samples with the experimental varieties and strains perhaps slightly higher in yield of flour. Otherwise, the baking and chemical results do not appear to be greatly different when compared with samples having approximately the same protein content.

Table 10.—Milling, baking, and chemical results on fifteen composite commercial samples of hard red spring wheat obtained at Great Falls, Montana; Duluth and Minneapolis, Minnesota, representing the 1952 crop.

Location Where Obtained	U. S. Grade	No. of Cars	Test Weight	Pearl- Index		Protein		Flour Yield		Absorp- tion	Mixing		Cc.	Score	Method
				Value	Wheat	Pct.	Pct.	Pct.	Pct.		Time	Bromate			
Duluth, Minnesota															
Do.	1 D.N.S.	337	59.5	33	14.2	13.2	75.4	.45		66	2.5	0	915	85	90
Do.	1 D.N.S.	467	59.6	34	14.1	13.5	75.3	.44		65	2.0	1	881	85	90
Do.	1 Hvy. D.N.S.	311	61.1	33	14.1	12.9	75.6	.44		66	2.5	1	845	90	90
Do.	1 N.S.	234	59.5	31	12.6	11.8	74.8	.47		65	2.5	0	776	80	95
Do.	1 N.S.	129	58.5	32	12.9	11.9	75.9	.45		66	2.5	0	776	85	90
Average Range			59.6	33	13.6	12.7	75.4	.45		66	2.4	.40	839	85	91
			2.6	3	1.6	1.7	1.1	.03		1	.5	1.00	139	10	5
Great Falls, Montana															
Do.	1 D.N.S.	47	59.8	30	14.6	13.7	72.1	.44		66	2.5	0	853	90	95
Do.	1 Hvy. D.N.S.	1348	61.8	30	14.1	13.4	72.5	.43		65	2.0	0	838	80	95
Do.	2 D.N.S.	45	61.5	29	14.2	13.4	72.2	.43		66	2.5	0	825	80	90
Average Range			61.0	30	14.3	13.5	72.3	.43		66	2.3	0	839	83	93
			2.0	1	.5	.3	.4	.01		1	.5	0	28	10	5
Minneapolis, Minnesota															
Do.	3 D.N.S.	185	57.5	32	14.2	12.9	72.2	.43		64	2.5	0	916	90	90
Do.	2 D.N.S.	220	58.8	32	13.8	12.9	74.0	.45		66	2.5	1	866	80	95
Do.	1 Hvy. D.N.S.	275	61.1	31	13.8	12.9	75.3	.46		66	2.5	1	866	75	85
Do.	1 D.N.S.	234	59.8	32	13.8	13.1	73.3	.43		65	2.0	1	860	80	95
Do.	3 N.S.	223	56.6	32	12.6	11.6	73.8	.43		65	2.5	1	788	75	90
Do.	2 N.S.	185	58.5	33	12.4	11.9	74.8	.43		65	2.5	0	785	85	95
Do.	1 N.S.	160	59.2	32	12.5	11.6	74.0	.44		65	2.5	1	773	80	90
Average Range			58.8	32	13.3	12.4	73.9	.44		65	2.4	.71	836	81	91
			4.5	2	1.8	1.5	3.1	.03		2	.5	1.00	143	15	10
Total Cars														4400	

# CORRELATION AND REGRESSIONS

Correlation coefficients ( $r$ ) for optimum loaf volume and flour protein content of five varieties and strains have been calculated and are presented in table 11. Also shown in this table is the slope of the regression line or the change in loaf volume for each 1.0 percent of protein ( $b_1$ ), the average protein content of the flour and the loaf volume of the bread, and the loaf volumes adjusted to a 13.0 percent protein basis by the means of the regression equation. The plotted regression lines for each variety are shown in figure 1.

The graph shows that the relation between loaf volume and protein content is generally linear. These results are in accordance with those of the last eight years (1944 to 1951) where, with a few exceptions, the points fell on or very close to the calculated regression lines. Most of the correlation coefficients for loaf volume and flour protein content are high. The highest coefficients are for Thatcher and Mida. The wheat having the lowest coefficient this season was Lee. It should be noted that the number of samples of each variety is rather small for a study of this kind. This fact should be considered in evaluating the results.

One of the important results of this study and of interest is the difference in level and particularly in the slope of the regression lines for the different varieties. A comparison of the regression lines shows that Rival is the best of the wheats and 1764 x Henry poorest in gluten quality. The change in loaf volume for 1 percent of protein was highest for Rival (62.8 cc) and lowest for 1764 x Henry (44.6 cc.). The loaf volume expressed on a 13.0 percent protein basis shows that Lee and Mida were the lowest and Rival the highest of the group.

Table 11. - Statistical summary of protein content loaf volume data for varieties of hard red spring wheat.

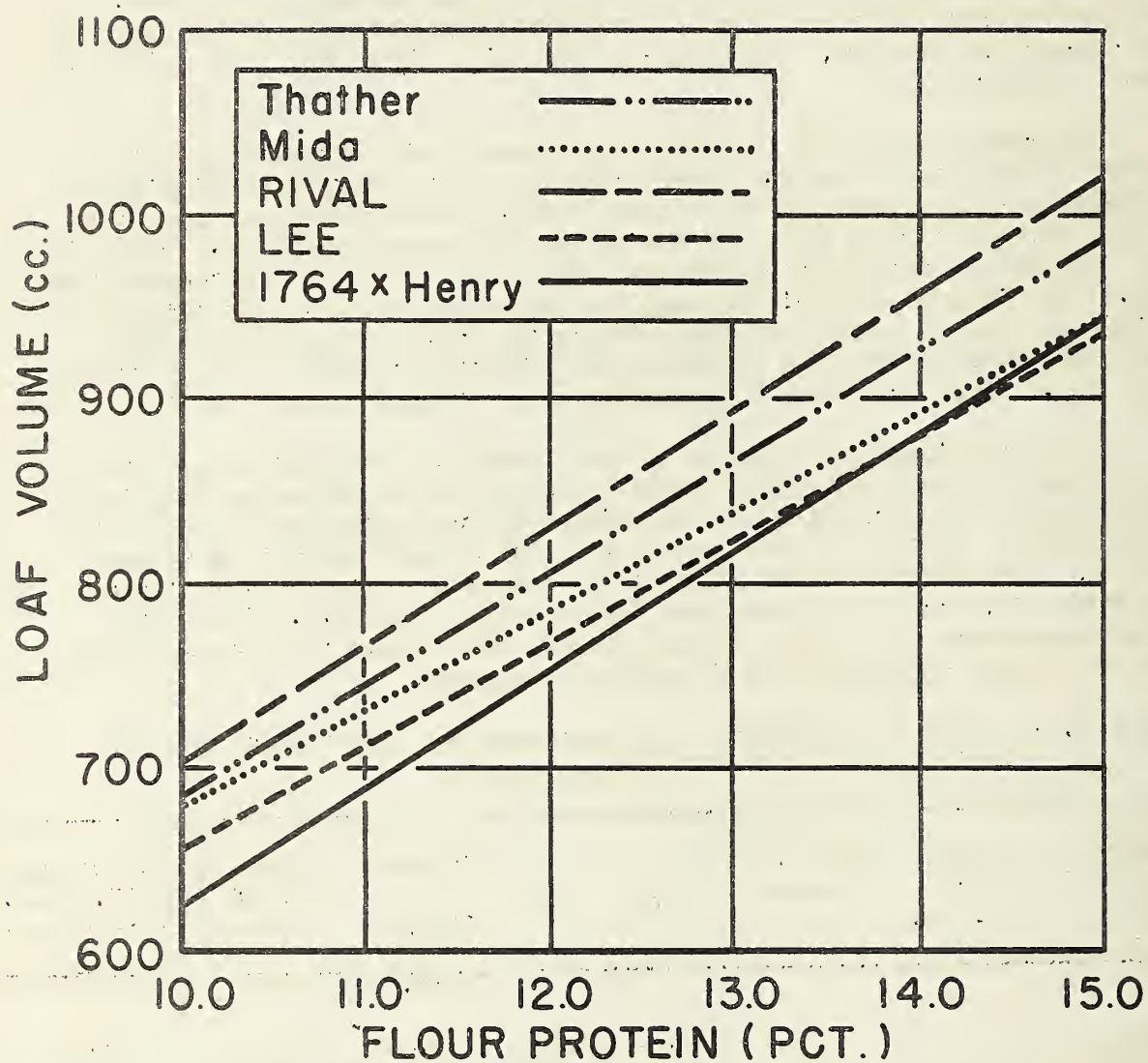
Variety or Cross	State or N. No.	No. of samples	$b_1$ 1/	$r$ 2/	Protein of flour	Average loaf volume	Loaf volume at 13.0 pct. protein con- tent 3/
			Cc		Pct.	Cc	Cc
Rival		13	62.8	.871	12.3	850	894
Thatcher		24	59.5	.906	13.4	887	864
1764 x Henry	2211	18	44.6	.896	13.4	874	856
Mida		17	53.2	.941	12.8	828	839
Lee		19	55.7	.857	14.2	888	822

1/ Slope of the regression line or the cubic centimeter change in loaf volume for each 1 percent of protein.

2/ Correlation coefficients for loaf volume and flour protein content. All correlation coefficients are significant at the 1 percent level.

3/ Calculated from regression equation.





**FIG. 1.-REGRESSION LINES FOR FLOUR PROTEIN AND LOAF VOLUME FOR FIVE HARD RED SPRING VARIETIES FROM THE 1952 CROP.**

NOTES ON SOME OF THE NEW STRAINS OF  
CURRENT INTEREST

Each year many new wheats are tested along with the leading commercial varieties for chemical composition, milling, and bread-baking quality. The data on eight new strains of current interest with averages expressed as a percentage of comparable samples of Thatcher are shown in table 12.

Thatcher x Surpresa, II-39-8

Thatcher x Surpresa, II-39-8, Minn. 2824 (CI. 12641) was developed at and first included in the Uniform Regional Nursery by the St. Paul, Minn., station in 1948. It has good leaf rust resistance and high yield.

Three samples of Minn. 2824 from the 1952 crop show it exceeded Thatcher in test-weight-per-bushel, protein content of wheat and flour, flour yield, loaf volume, crumb color and grain and texture of bread. It averaged considerably lower than Thatcher in ash content of flour. These results are in agreement with the previous 2 year's tests. The dough mixing time of Minn. 2824 has been found to be considerably shorter than that of Thatcher. A short dough mixing time such as found in Minn. 2824 is objectionable. The dough handling properties of Minn. 2824 were slightly weak and sticky and inferior in this respect to the standard accepted varieties. It has consistently averaged higher in protein content than Thatcher grown under comparable conditions.

1764 x Henry

The strain 1764 x Henry, N. No. 2211 (C.I. 12733) was included in the Uniform Regional Nursery for the first time in 1949. It is a very early bearded wheat, and has moderate resistance to leaf rust.

The average of 18 samples shows that N. No. 2211 is comparable to Thatcher in test-weight-per-bushel, protein content of wheat and flour, water absorption, dough-mixing time, loaf volume, and grain and texture of bread. It is 2.0 percent lower than Thatcher in flour yield and .04 percent lower in flour ash content. Most samples of it have generally milled satisfactorily, but some have shown a tendency for the middlings to be difficult to reduce to flour. N. No. 2211 is slightly better than Thatcher in crumb color of bread. The dough characteristics are satisfactory, but not so strong as in Thatcher. It is a wheat of good strength considering the data as a whole, but not as strong as Thatcher.

McMurachy-Exchange x Redman<sup>3</sup>

McMurachy-Exchange x Redman<sup>3</sup> RL2624 (C.I. 12953) is a Canadian selection. It has shown resistance to 15B stem rust at lower temperatures. A limited number of milling and baking tests in the United States and Canada last year showed it to be similar to Marquis in quality.

The protein content of wheat and of flour of two samples of McMurachy-Exchange x Redman<sup>3</sup> was one percent greater than those for comparable samples of Thatcher.

It is very similar to Thatcher in test-weight-per-bushel, yield of flour, flour ash, water absorption, dough mixing time and grain and texture of bread. It was slightly lower in loaf volume of bread, but better in crumb color than Thatcher. The dough handling properties based on the testing of only two samples were found to be generally satisfactory. It milled satisfactorily and produced a granular type flour. It appears from these limited tests to be generally satisfactory for bread, but not quite so strong as Thatcher.

Frontana x Thatcher, II-46-53

Frontana x Thatcher, II-46-53, Minn. 2855 was developed at St. Paul, Minnesota. It has shown good 15B stem rust resistance.

Comparable milling and baking tests show that Minn. 2855 has exceeded Thatcher with respect to protein content of wheat and flour, test weight per bushel and crumb color of bread. It has been one of the better strains in wheat protein content averaging 2.7 percent higher than Thatcher. It averaged considerably lower than Thatcher in ash content of flour. Minn. 2855 is very similar to Thatcher in flour yield, loaf volume of bread and grain and texture. It has a short dough mixing time averaging 50 percent less than that of Thatcher. This is an objectionable characteristic of Minn. 2855. The dough handling properties from these limited tests made on two samples were weak and inferior to those of the approved varieties. It has shown satisfactory milling properties.

Triunfo x Thatcher 630

Triunfo x Thatcher 630 (C.I. 12625) developed in South Dakota was grown at three of the stations in that State in 1952.



Based on the average of three comparable samples Triunfo x Thatcher 630 has exceeded Thatcher in test weight per bushel, protein content of wheat and flour and crumb color of bread. It averaged 2.5 percent higher in wheat protein content than Thatcher. It was lower in flour ash, water absorption, bread loaf volume and grain and texture. The dough mixing time of Triunfo x Thatcher 630 is much shorter than that of Thatcher. The dough characteristics appear to be satisfactory from the tests made, but are not as strong as many of the acceptable varieties. It is a softer wheat than most of the approved hard red spring varieties and yields about 2.0 percent less flour than Thatcher. Two of the samples tested this year have shown questionable milling properties, handling much like a soft wheat in the mill.

Frontana x Thatcher, II-46-13

Frontana x Thatcher, II-46-13, Minn. 2854 (C.I. 13030) was developed at St. Paul, Minnesota, and has shown good 15B stem rust resistance.

Comparable milling and baking tests of three samples show that Minn. 2854 exceeds Thatcher with respect to test weight per bushel, protein content of wheat and flour and crumb color of bread. It has been one of the better samples in wheat protein content averaging 1.6 percent higher than Thatcher. Although high in protein content, the loaf volume is lower than expected, indicating that the quality of the gluten is not as strong as some of the approved varieties. The dough mixing time for Minn. 2854 is shorter (50 percent) and more critical than for Thatcher. It produced a dough that was sticky and weak. One sample of Minn. 2854 milled satisfactorily, but the other two were questionable. They milled soft and the middlings were difficult to reduce to flour which bolted slow. It averaged about 5.0 percent less in flour yield than Thatcher. This strain appears inferior to the approved varieties in quality.

Timstein x Henry, II-44-65

Timstein x Henry, II-44-65 (C.I. 13026) developed at St. Paul, Minnesota, was grown in the Uniform Regional nursery for the first time in 1952.

Two samples of Timstein x Henry II-44-65 show that it exceeded Thatcher only slightly in test-weight-per-bushel, protein content of wheat and flour and crumb color of bread. It averaged 25.0 percent shorter in dough mixing time, was lower in loaf volume and water absorption than Thatcher. It was slightly lower in flour ash than Thatcher. It made bread of good grain and texture and the dough handling properties were satisfactory. It milled well but produced slightly less flour than Thatcher. This is a promising strain from the tests made thus far.

Rushmore<sup>2</sup> x Surpresa P.W.36

Rushmore<sup>2</sup> x Surpresa P.W.36 (C.I. 12972) developed at Brookings, South Dakota, was grown at a number of the locations in the spring wheat area in 1952.

Six comparable milling and baking tests show that Rushmore<sup>2</sup> x Surpresa P.W.36 exceeds Thatcher in test weight per bushel and protein content of wheat and flour. It has been one of the better strains in wheat protein content exceeding Thatcher by 2.8 percent. P.W.36 was lower in yield of flour, water absorption, and loaf volume, crumb color and grain and texture of bread than Thatcher. It has a considerably shorter (50.0 percent) dough mixing time than Thatcher and weak dough characteristics. The milling properties of P.W.36 were generally satisfactory. This does not appear to be a very promising strain and the results would indicate that it is inferior to the approved varieties.

Table 12.-Comparison of the yield per acre, test weight per bushel, milling, baking and chemical properties of eight varieties of wheat with the variety Thatcher, 1952 crop.

Variety or Cross	Pearl-			Protein			Flour			Absorp-:Mixing:			Optimum Baking Method		
	No. of: Acre:	Test:	ing:	Wheat:	Flour:	Yield:	Ash:	Pct.	Pct.	Pct.	tion:	Time:	Bromate:	Loaf:	Crumb: Grain
	Samples:	Yield:	Weight:	Index:	Value:								Volume:	Color:	Texture
	Bu.	Lbs.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Min.	Mgs.	Cc	Score	Score
Thatcher x Surpress, II-39-8	3	24.2	61.7	29	13.5	12.2	75.1	.45	61	1.7	.33	817	83	92	
Thatcher	3	18.5	57.4	22	12.7	11.5	73.7	.52	62	2.2	.67	758	70	88	
Percentage of Thatcher		130.8	107.5	131.8	106.3	106.1	101.9	86.5	98.4	77.3	49.3	107.8	118.6	104.5	
1764 x Henry, N. No. 2211	18	18.3 1/2	58.4	29	14.4	13.4	72.0	.43	65	2.0	1.00	874	79	88	
Thatcher	18	17.8	58.9	27	14.3	13.3	74.0	.47	64	2.2	.56	879	76	88	
Percentage of Thatcher		102.8	99.2	107.4	100.7	100.8	97.3	91.5	101.6	90.9	178.6	99.4	103.9	100.0	
McMurechy-Exchange x Redman <sup>3</sup>	2	22.4	57.8	31	15.5	14.6	74.9	.49	64	2.0	2.00	927	88	93	
Thatcher	2	19.6	58.4	29	14.6	13.6	74.1	.49	64	2.0	.00	940	83	93	
Percentage of Thatcher		114.3	99.0	106.9	106.2	107.4	101.1	100.0	100.0	100.0		98.6	106.0	100.0	
Frontana x Thatcher, II-46-53	2	23.5	58.1	35	16.4	15.1	72.5	.43	61	1.0	1.50	838	90	93	
Thatcher	2	13.5	54.7	22	13.7	12.6	73.1	.50	62	2.0	1.00	853	75	93	
Percentage of Thatcher		174.1	106.2	159.1	119.7	119.8	99.2	86.0	98.4	50.0	150.0	98.2	120.0	100.0	
Triunfo x Thatcher 630	3	16.5 2/3	60.8	37	15.9	14.6	72.2	.48	59	1.2	0	839	85	73	
Thatcher	3	13.0	58.7	27	13.4	12.5	74.3	.51	63	2.2	0	855	77	87	
Percentage of Thatcher		126.9	103.6	137.0	118.7	116.8	97.2	94.1	93.7	54.5	100.0	98.1	110.4	83.9	
Frontana x Thatcher, II-46-13	3	23.9 2/3	59.1	33	15.8	14.8	69.5	.44	59	1.0	1.70	829	95	93	
Thatcher	3	19.6	58.1	27	14.2	13.1	74.4	.43	64	2.0	.33	901	78	92	
Percentage of Thatcher		121.9	101.7	122.2	111.3	113.0	93.4	102.3	92.2	50.0	515.2	92.0	121.8	101.1	
Timstein x Henry, II-44-65	2	25.7	59.0	33	14.9	13.8	71.5	.45	62	1.5	2.00	845	88	93	
Thatcher	2	19.6	58.4	29	14.6	13.6	74.1	.49	64	2.0	.00	940	83	93	
Percentage of Thatcher		131.1	101.0	113.8	102.1	101.5	96.5	91.8	96.9	75.0		89.9	106.0	100.0	
Rushmore x Surpresa P.W.36	6	20.7	60.5	38	15.7	14.1	71.9	.48	59	1.0	.50	706	71	69	
Thatcher	6	15.5	57.5	27	13.9	12.9	73.7	.47	63	2.1	.17	888	79	90	
Percentage of Thatcher		133.5	105.2	140.7	112.9	109.3	97.6	102.1	93.7.	47.6	294.1	79.5	89.9	76.7	

1/ Average of 17 samples.

2/ Average of 2 samples.



